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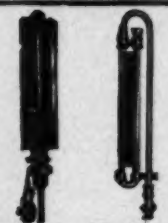
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AMERICAN
GAS JOURNAL

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The Fuel of the Future–What Shall it be?

XII. Part 1. The industrial gases. What they are, their properties and uses

Ismar Ginsberg

IN THE article previous to this one, the commercial side of the industrial gas business was discussed. It was shown how certain principles had to be followed in selling industrial gas. The importance of using selective arguments, that applied exactly to the case in question, was emphasized, and in general the entire aspect of the merchandising end of the industrial gas business was gone over in detail.

There is still one other matter that remains to be considered before taking up the individual industrial uses of gas, and, that is, what does the industrial gas engineer sell? True, he sells gas, but what kind of gas does he sell, and does it make any difference to him or to his company, or, for that matter, to the entire gas industry, just what are the properties of the gas that he sells? Is one gas better suited to industrial application than another, or is the difference such that it does not matter? Is it necessary to use one gas differently than another, or can they all be employed in the same way? These are important questions and require careful consideration and study.

The Heat Value of the Gas

In the first place, what does the industrial gas man really sell? Does he sell a gas or does he sell heat? Off-hand, the answer to this question would be that he sells heat. This is true enough and under ordinary conditions it makes rather little difference in what manner this heat arrives at the point where it will be used. As long as the price of the gas is commensurate with the heat values that it contains, it may make but little difference within certain well-defined limits whether the gas contains a high concentration of heat values or a low concentration of heat values.

But conditions do arise where it is necessary to effect heating operations in which the high concentration of heat values in the gas is of decided advantage and in those cases it does make a difference as to what heat values are contained in the gas. But it may be held that for most of the purposes to which gas is put in industrial operations the concentration of the heat values in the fuel is not of such importance (at least, where the difference in calorific power is not great) that one kind of gas will have any very considerable advantage in a technical sense over another. Furthermore, it must be remembered that the situation is not one of great elasticity, for the industrial gas engineer has to sell the gas that is made by his company under conditions regulated by state or municipal law, and he must obtain the best results he can with the fuel that is rendered available to him.

The Different Gaseous Fuels

There are quite a few gaseous fuels. There is, of course, natural gas, which must be given a certain amount of attention at this point. Then there are the various manufactured gases, such as coal gas, blue water gas, carburetted water gas, producer gas, blast furnace gas, coke oven gas, oil gas, and the like. Each of these gases will be described in turn and their most important properties will be indicated.

Natural Gas

Natural gas has no real place in a course of study which is concerned with central station manufactured gas, but its properties should be understood by the gas engineer so that he can appreciate their value and be able to compare them with similar properties of the gas that he is selling.

Natural gas is a mixture, not a single chemical compound, of various highly combustible constituents that are made by some secret process of Nature. It is the only refined fuel which is derived from the earth ready for use. It is obtained from the earth by the well-known drilling process, sections being selected for drilling operations where the geology indicates the probable occurrence of the gas in the oil or gas sands, located at many hundred or thousand feet below the surface The gas is then led away through pipe lines to the various points at which it is used, pumping stations being installed at regular intervals to keep up the pressure of the gas in the mains.

The natural gas industry is a large industry today, but its limitations are now fairly accurately fixed. It certainly does not possess the possibilities of manufactured gas as an industrial fuel, for the first important quality of an industrial fuel, in fact, of any fuel, is unlimited supply, which, no one will deny, is not possessed by natural gas.

Properties of Natural Gas

Natural gas has a maximum heating value in the neighborhood of 1,200 British thermal units per cubic foot. Sometimes the heating value is as low as 700 B.t.u. per cubic foot. The specific gravity of the gas is generally from 0.6 to 0.7, referred to air as unity, which makes it weigh about 45 to 55 pounds to the thousand cubic feet.

The composition of some natural gases is shown in the following table:

TABLE 1

Source	Analysis by volume							
	Oxygen	Methane	Ethane	Hydrogen	Carbon Monoxide	C_2H_4	N_2	Carbon Dioxide
West Virginia	0.4	99.5	0.1	....	...	...	...	...
Kansas	0.25	98.3	..	....	0.25	...	1.2	...
Indiana	0.3	94.16	..	1.7	0.55	0.3	2.8	0.29
Ohio	0.35	93.85	..	2.74	0.44	0.2	2.98	...
Pennsylvania	...	80.11	..	13.5	...	5.72	...	0.66
Pittsburgh, Pa.	0.8	67.00	5.0	22.00	0.60	1.00	3.00	0.6

The figures in this table clearly show that there is a considerable variation in the percentage composition of natural gas. The table also shows that the principal heat-producing constituent of the gas is methane, which is the simplest hydrocarbon, having a formula, CH_4. Hydrogen is also a heat-producing ingredient of the gas, and some gases, as seen above, also contain small amounts of the higher hydrocarbons, ethane, C_2H_6, and ethylene, C_2H_4. Carbon monoxide is also contained in the gas and adds to its calorific power. Oxygen, carbon dioxide and nitrogen are merely diluents and do not add any value to the heating capacity of the gas, although oxygen possesses a certain advantage in aiding in its combustion.

Products of Combustion of Natural Gas

Inasmuch as natural gas is almost entirely methane and also contains in certain cases appreciable percentages of hydrogen, it must be remembered that its combustion will yield a certain quantity of water vapor, as hydrogen in burning and combining with oxygen produces water. It is estimated that under certain conditions there will be as much as ten gallons of liquid water formed in the burning of one thousand cubic feet of the gas, and this must be reckoned with, for in certain industrial operations it may be troublesome and injure the product of manufacture.

In burning natural gas, the amount of air required will, of course, vary with the composition and the calorific power of the gas, but on the average a cubic foot of natural gas will need approximately 9.5 cubic feet of air to effect complete combustion.

Distribution of Heat in the Burnt Gas

At this point it may be interesting to consider the distribution of heat in the burnt natural gas in comparison with other manufactured gases. Thus, if the natural gas has a calorific power of 1200 B.t.u. per cubic foot, it will take about 11 cubic feet of air to effect complete combustion. This will mean that the intensity of the heat throughout the burnt gases will be approximately 100 B.t.u. per cubic foot, there being in all 12 cubic feet of mixed gases.

On the other hand, a manufactured gas having a calorific power of 600 B.t.u. per cubic foot will require about 5.5 cubic feet of air for complete combustion. This means that in this case the total volume of the gaseous mixture is 6.5 cubic feet and that there will be available approximately 92 B.t.u. in each cubic foot of the mixture.

The difference between coal gas and natural gas of maximum heating value is not great, but that between coal gas and producer gas is rather considerable. Where great intensity of temperature is required, producer gas should not be used. Greater intensity of temperature can be obtained with natural gas than with coal gas, but the difference is not very considerable.

(Continued on page 803)

*Relative Value of Fuels

A few pertinent observations of special interest to gas men

R. O. Wynne-Roberts

THE present day commercial fuels offer a wide variety of choice, and while solid, liquid, and gaseous fuels have each their particular sphere of utility and efficiency, probably gaseous fuel is in general the most efficient. All solid and liquid fuels have to be gasified, and the energy of electricity has to be applied to heat an element, before the advantageous use of the same can be obtained. Each fuel requires to be studied independently, if its heat value is to be developed in a proper manner so as to derive full economic value.

The fact that coal-gas contains about 600 heat units per cubic ft., or natural gas about 1,000 B. T. U., or coal about 12,000 B. T. U. per pound, or liquid fuel about 19,000 B. T. U. per pound, is not a conclusive index of their relative ultimate values.

The B. T. U. in Gas Not the Sole Criterion of Its Value

One gaseous fuel may be more efficient than another, because its composition may be satisfactory. All fuels have to receive a certain volume of air (or more correctly oxygen) for efficient combustion. When the mixture of gas and air is ignited heat is evolved, but the temperature of such heat, before its dissipation, will not necessarily be proportional to the heat values in the original fuel. Research work conducted by various gas organizations on this continent indicates that the combustion of blue-gas containing only 310 B. T. U. produces more heat energy and a higher flame temperature for the same cost than either natural gas, or producer gas.

Heat Service

In the final analysis, the fuel which yields the maximum heat service per dollar is the cheapest one to use. The term heat service, however, covers a multitude of factors with which the lay consumer should be made familiar. The average consumer is not concerned in an academic discussion about high or low heat values of a fuel. He is vitally interested in the uniform quality of the article he manufactures, greater production of a better quality of commodity per dollar of investment, reliability of the steady supply of fuel, control of temperature, simplicity and cost of operation, and minimum losses due to unsatisfactory manufacture of a commodity.

With the present high cost of living and of manufacture, it is important that even housewives be shown how the best heat service can be obtained, such as what constitutes a satisfactory flame, how wastes may be eliminated, and how the gas and air supplies may be satisfactorily adjusted.

*Delivered at the annual convention of the Canadian Gas Journal.

Waste Is Incurred in Use of All Fuels

It is admitted that waste takes place in the use of all fuels. Coal-gas is often used inefficiently. Solid fuels are wasted on all sides. Oil men admit that liquid fuels are often used extravagantly. Electricians recognize that electricity is used efficiently only under certain conditions. The application of proper methods in the utilization of fuels has not yet become general, and moreover there is a tendency to disregard efficiency when fuel is cheap, unless concrete examples of economy are prominently brought to the attention of the public and the latter are persistently educated to use the best methods. The greatly increased cost of coal has impelled coal-gas engineers to make an intensive study of the use of low grade gas, and it has been ascertained by scientific research and by experience that high B. T. U. value is not the primordial requirement, but an optimum mixture is necessary to secure a complete, rapid, and efficient combustion at the burner head. A fully aerated flame, short and hot, with an effectual contact with the part of the upper cone where combustion is complete, is essential for high efficiencies.

Relative Value of Gas and Other Fuels

It is desirable in this connection to present authentic data on the relative value of gas and other fuels, but there seems to be a paucity of published information as to actual experience. The following notes have been collected from various sources and are presented in the hope that they will serve the purpose intended.

The U. S. Department of the Interior (Bureau of Mines) has a number of kitchen tests made by the Department of Home Economics of the Ohio State University in 1917, as a part of the program of natural gas conservation. These tests were made under the careful supervision of capable officials to ascertain the relative cost of natural gas, coal, oil, gasoline and electricity for cooking.

The following table will give in concise form the summary of the results of B. T. U. consumed:

RESULTS OF KITCHEN TESTS MADE BY THE DEPARTMENT OF HOME ECONOMICS, OHIO STATE UNIVERSITY

	1,000 B.t.u. Natural Gas	12,000 B.t.u. Soft Coal	19,000 B.t.u. Coal Oil	19,000 B.t.u. Gasoline	3,412 B.t.u. Electricity
Breakfast for six	10,000	132,000	20,900	17,100	3,412
Luncheon for six	24,000	138,000	45,600	28,500	10 [illegible]6
Dinner for six	22,000	93,600	43,700	20,900	[illegible]9
Baking 4 loaves.	10,000	78,000	7,980	8,360	[illegible]2
Total B.t.u.	66,000	441,600	118,180	74,860	22 850

Relative percentage efficiency based upon electric range at 100 per cent	34.7	5.18	19.35	30.50	100

While the electric range is not 100 per cent efficient, we may assume it as such, in order to make comparisons between it and other ranges. If the electric range in ordinary practice has only 50 per cent efficiency, then the other percentages will be reduced proportionately. An electric water heater will probably give 90 or 95 per cent efficiency, because the element is immersed in water and the lost waste heat is minimized.

Efficiency of Gas of Different Qualities

The U. S. Bureau of Standards in 1922 conducted a series of carefully supervised tests to determine the efficiency of gas of different qualities and applied the heat to a vessel containing two quarts of water. The pressure was equal to a three-inch column of water. The following figures are taken at random from the report:

B.t.u in Gas	Cu. Ft. Consumed	Total B.t.u.	B.t.u. in Gas	Cu. Ft. Consumed	Total B.t.u.
608	2.33	1,420	453	3.24	1,466
557	2.64	1,470	448	3.26	1,460
549	2.66	1,460	401	3.58	1,440
505	2.91	1,470	352	4.18	1,470
491	2.98	1,465	297	4.96	1,470

The average heating value of the air and gas mixture was about 180 B. T. U. The conclusions deduced by the U. S. Bureau of Standards were that efficiency of utilization of manufactured gas is independent of the nominal heat unit per cubic foot in the gas, and that the monetary value of the gas is directly proportional to its heating qualities for practical purposes.

The Ohio State University tested some ranges under different pressures, and it was found that the efficiencies obtained from natural gas were from 14 per cent under 5 inch pressure, to 43 per cent under 0.2 inch pressure.

Surface combustion methods appear to yield good results. A perfect mixture of gas and air in which the constituents are in a state of intimate neutral collision projected against areas of incandescent solids produces reaction which is flameless and invisible. Perfect combustion is said to be obtained and the gas is entirely consumed, releasing the total available energy for service. Bone and McCourt applied this method to a steam boiler and claimed to have obtained about 95 per cent thermal efficiency, which is, of course, very high.

Comparisons of Gas and Electric Baking Ovens

The Hydro-Electric Bulletin for September, 1923, quotes an interesting case where electric and gas baking ovens were tested in New York City, with electricity at 3 cents per kw.-hr., and manufactured gas at $1.15 per thousand cubic feet. The electric oven cost about $100 per month as compared with $45 per month in the case of the gas oven. The reviewer, however, stated that heat generated by a fuel is not the basis of comparison, but the heat actually utilized.

It is noticeable that United States Utility Commissioners are recognizing that the efficiency of gas utilization is not dependent on the calorific value of the fuel when used for ordinary commercial purposes.

Comparative House Heating Tests

Tests made in Pennsylvania with a house heater natural-gas furnace under careful control gave 68.2 per cent efficiency, but in a coal hot air furnace only 48.3 per cent. Mr. E. J. Stephany, of Pittsburgh, calculated that one ton of coal having 13,000 B. T. U. per pound, consumed with 55 per cent efficiency, was equal to 20,000 cubic feet of natural gas containing 1,000 cubic feet consumed at 75 per cent efficiency.

The Iowa State College made tests with house heating furnaces and found the efficiency with local coal was from 42 to 65 per cent.

The U. S. Bureau of Mines recently made many tests as to the efficiency of house heating boiler furnaces under scientific control. It was found that with coke, 57 to 72 per cent efficiency was obtained; with anthracite, 58 to 75 per cent; and with bituminous coal, 49 to 64 per cent.

The heating of the Singer Building in New York with coal firing gave an over-all efficiency of 68 per cent, and with oil firing nearly 80 per cent.

Efficiency tests made of a powdered-coal firing of two Sterling steam boilers with super-heaters at St. Joseph, Mo., by the U. S. Bureau of Mines, gave an average of 78.8 per cent, while other tests at Milwaukee gave 7 to 8 per cent higher results.

Under average conditions obtained in households, factories, etc., the thermal efficiencies are not as high as reported above, although theoretically they should be the same.

The thermal efficiencies secured with the combustion of various fuels are too well known to you to need quoting. The range of efficiencies, however, is most striking and the waste in the aggregate is exceedingly great. Why should such convenient fuels as gas and oils ordinarily yield low results, when by simple adjustments on suitable appliances greater economies could be effected?

Comparison of Fuels on Basis of Economy and Service

Fuel is often purchased with little regard to true economy and service. Comparison of one fuel with another is often made on the basis of price only and at other times on both heat units and price. If we regard both coal and coal-gas as 100 per cent efficient, then the relation between coal containing say 13,000 B. T. U. per pound at $13 per ton and coal-gas containing say 600 B. T. U. per cubic foot at $1 per 1,000 cubic feet would be

$$\frac{13{,}000 \times 2{,}000 \times 100}{600 \times 1{,}000 \times 1{,}300} = 3.33$$

that is to say on the basis of price only coal-gas would cost 3 1-3 times that of coal.

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GAS MERCHANDISING

Domestic ~ Industrial

Ideas of Interest to the Man Who Sells

William H. Matlack

We have said again and again, "Tell 'em and you'll sell 'em." The hard part is telling folks at the psychological moment, when they want to buy or when they are in the act of buying or paying for a purchase made, as in the case of gas service. Many floor sales have been lost, as any floor salesman will tell you, for the simple reason that no one got to the prospect before he got to the door leading to the street. He will also tell you that if there had been some quick way to get price and terms before the prospect he would have been held—by initial interest in the appliance and the price and terms—long enough for a floor salesman to have reached him, aroused his interest and created a desire to buy. In many instances a sale would have been closed then and there. But all the prospect saw was a range or other appliance that interested him and from which there hung a tag marked "$50.00 Time, $45.00 Cash, $10.00 down, $5.00 per mo."

The Remedy

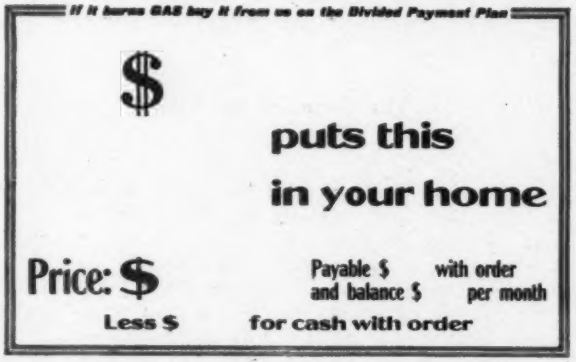
In order to obviate this and to get our prices and terms to the attention of folks who come into our store while our floor salesman is busy, we have had a card printed which we use on all appliances. This card, which is reproduced here, is so designed that it tells the whole story quickly and fully. The down payment, which is in our case always the smallest payment, is lettered in at the top, then follow the price and the terms, with the cash discount coming last.

It is our contention that a gas appliance properly sold on the Divided Payment Plan should have as its down payment the low one, for we feel that the hard work is getting the customer to sign the contract. But, on the other hand, we believe that if she has been SOLD and has used the appliance for thirty days, she will so appreciate its convenience that she will make the balance of the monthly payments, even if baby's bank has to be taken to the basement and opened to raise the money.

Another reason why we favor pricing all appliances in big plain figures is that time and time again we have made sales to folks who at the outset were simply curious, who could not resist the dollar and cent signs and who really felt that they could not afford a new range or water heater until they saw how inexpensive they really were and we had told them our story.

Do You Take Your Own Medicine?

In talking to a gas man a week or so ago, the question was asked in regard to a certain city: "Why is ——— such a poor water heater town?" There were many reasons advanced; folks just would not buy or this, that or the other, and finally the subject was dropped and no real reason given. But, listen, here's the answer: We happen to know the town and some of the gas folks, we know, shout, "Buy a Water


If it burns GAS buy it from us on the Divided Payment Plan
$
puts this
in your home
Price: $
Payable $ with order
and balance $ per month
Less $ for cash with order

Heater for Your Home," "Hot Water Always on Tap," and a lot of other things meaning that no home is complete without hot water service and that it's a shame more folks don't have an ever-abundant supply. But the reason they don't sell more water heaters—oh, that's because they won't take their own medicine. Every gas man should have hot water service in his home, know by actual usage what hot water service is, and then he can tell folks about it with authority—not by catalogue talk.

Stocks Effect Turnover

When you consider turnover, remember that large stocks decrease the speed of turnover as well as tie up capital, and should be avoided. This is especially

(Continued on page 806)

Selling Gas Ranges in a Special Sale

How it was done in Kansas City

J. L. Simpson

WHILE the manager of the Kansas City Gas Company modestly disclaims any special ingenuity in the matter of putting over the sale of a record number of gas ranges in a given period of time, we may very honestly inquire into the methods which result in the sale of eight or nine hundred gas ranges, during special sales of ten days' to two days' duration.

During a recent sale, for instance, we may note that advantage was taken of a certain condition which recently arose, and that condition was a considerable advance of the price of gas in Kansas City. What, then, under these conditions, would be a great contributing factor in the success of a special sale? "Why, a gas burner whose distinctive feature is the promotion of economy in the use of gas."

This feature of the type of gas ranges, sold during the recent special sale, was successfully exploited as one of the "high lights" of the sale. And, moreover, this feature was explained and personally demonstrated to the thousands of visitors and prospective customers who visited the headquarters of the gas company during and prior to the special sale. Hence it is something more important than a mere "talking point"; in fact, it is a proven reality, a real money saver for the hundreds of Kansas City housewives who purchased gas ranges for summer use.

The Terms of the Sale

In a special sale, the matter of terms is invariably one for the most serious consideration upon the part of those responsible for the success of a sale where perhaps as much as $100,000 worth of merchandise is involved. In outlining the plans in regard to this important matter, a plan was devised which hit the popular fancy or approval.

In this sale, a down payment of only 75 cents was required of the purchaser, the balance to be paid in monthly payments covering a period of eighteen months. No matter what the size of the range, the down payment of "six bits" placed it in the purchaser's home. On a fairly high-priced range, the amount of the monthly payments would be $6.75 for each of the eighteen payments, while on a cheaper model the monthly payment would be only $4.25, and so on.

A placard attached to each of the ranges displayed upon the floors of the gas office gave this information, as well as the total amount saved by the purchase during this special sale, as compared to the regular price if purchased at other times. Of course, the higher priced the range, the greater the amount of this saving, which naturally tended to the sale of the maximum number of the higher-priced stoves.

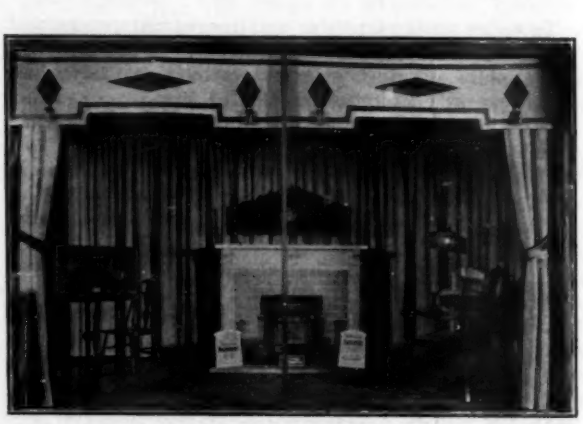
Automatic Lighter Given Away Gratis

In connection with the matter of terms, a leading feature of the sale was the gift of an automatic lighter with each range sold during the special event. Thus, by a simple "twist of the wrist," without the use of a match, the gas range is ready for use, and the novelty, as well as the utility of this feature, acted as an efficient advertiser for the sale. Cards announcing the gift of the automatic lighter with each range sold were posted in dozens of places throughout the store, showing the importance of this feature in promoting sales.

Thus, the various features of the selling plan outlined for this sale combined in an effective manner to reduce sales resistance to the minimum, to make it easy for every family in Kansas City, who needed a gas range, to place it in the home at an insignificant down payment, and at the same time to secure a range which would produce the optimum results in the way of cooking with a minimum expenditure for gas.

The System of Displays

Another factor which helped to carry the special sale over in good shape was the matter of displays, both floor displays and those in the two windows. The entire floor, which is by no means one of limited space, was given over to the display of



ranges, in proximity to one another, yet with pleanty of space between for the "circulation" of customers and visitors.

A great deal of faith was placed in the window displays, which were both artistic and practical,

(Continued on page 807)

INDUSTRIAL GAS LESSONS

IF IT'S DONE WITH HEAT — YOU CAN DO IT BETTER WITH GAS

Lesson No. 35

Expansion Effect of Heat (continued)

The Temperature-Volume Law

There is a very definite mathematical relation between the volume of a gas and the temperature. The law which expresses that relation was simultaneously discovered by Gay-Lussac in France and Charles in England. The law states in simple terms that the volume of all permanent gases increases uniformly as the temperature increases, so that the volume of a gas at 0 degrees F. will be found to have increased by one four hundred and sixtieth at 1 degree F. and this increase will be the same for each degree Fahrenheit rise in temperature. In other words, if the temperature increases to 460 degrees F., the original volume of the gas will have been doubled.

All Gases Do Not Expand Alike

The wording of the original law indicated that it applied to all permanent gases, which simply meant those gases which do not become liquids under ordinary temperature and pressure conditions. It has, however, been found that there is a difference in the rate of expansion of different permanent gases, that they do not all increase or decrease exactly by one four hundred and sixtieth of their volume for every increase or decrease of one degree Fahrenheit in temperature. The rate of volume change is quite different for some gases than for others, but in all practical calculations it may be assumed, without entailing any great error, that the increase in volume for each degree Fahrenheit increase in temperature is one hundred and sixtieth part of the original volume. This assumption will also be used in calculating the volumetric changes that take place in coal gas and other commercial gaseous fuels.

The Formula for Temperature-Volume Change

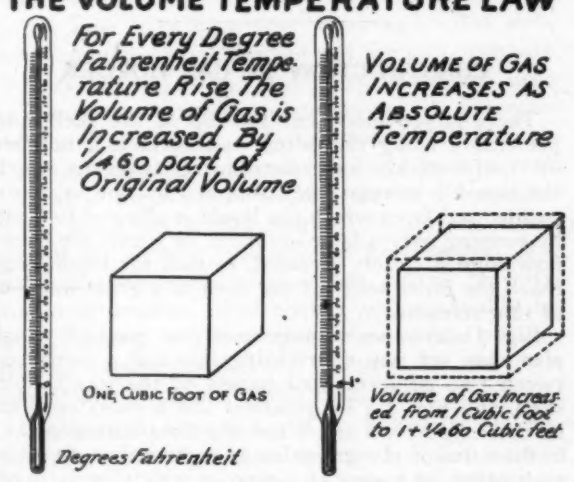
It has already been stated that Gay-Lussac's law expressed in simplest terms states concisely that the volume of a gas varies in accordance with its absolute temperature. Thus in the following equation, V_t is the volume of the gas at any temperature, V_o is the volume of the gas at any original temperature, T is the absolute temperature of the gas at temperature t, and T_o is the absolute temperature of the gas at temperature t_o, the original temperature. The formula then reads:

$$\frac{V_t}{V_o} = \frac{t + 460}{t_o + 460} = \frac{T}{T_o}$$

Use of the Formula

For example, the volume of a quantity of hydrogen gas at zero degrees F. is ten cubic feet. What is the volume of this gas at a temperature 460 degrees F.? The pressure during the temperature change remains constant at 30 inches of mercury (ordinary atmospheric pressure).

As the temperature increases the volume must increase. Therefore, it follows that the original volume, ten cubic feet, must be multiplied by a fraction in which the numerator is greater than the denominator. Furthermore, the volume increases as the absolute temperature; hence 460 degrees will have to be added to each temperature, giving 460 + 0, or 460, and 460 + 460, or 920.


THE VOLUME TEMPERATURE LAW
For Every Degree Fahrenheit Temperature Rise The Volume of Gas is Increased By 1/460 part of Original Volume
VOLUME OF GAS INCREASES AS ABSOLUTE Temperature
ONE CUBIC FOOT OF GAS
Volume of Gas Increased from 1 Cubic Foot to 1+1/460 Cubic Feet
Degrees Fahrenheit

The new volume will then be $10 \times \frac{920}{460}$, or 20 cubic feet.

If the volume of the original gas was ten cubic feet at a temperature of 400 degrees F. and it is desired to find the volume at a temperature of 30 degrees below zero, the new volume can be found as follows:

In this case, as the temperature decreases, the volume must decrease as well. This means that the original volume will have to be multiplied by a fraction in which the numerator is less than that of the denominator and in which both numerator and denominator are formed by adding 460 to the given temperatures.

Thus the new volume becomes equal to the following:

$$10 \times \frac{430}{860}, \text{ or } 10 \times 2 = 20 \text{ cubic feet.}$$

The Fundamental Rule for Volume Change With Temperature

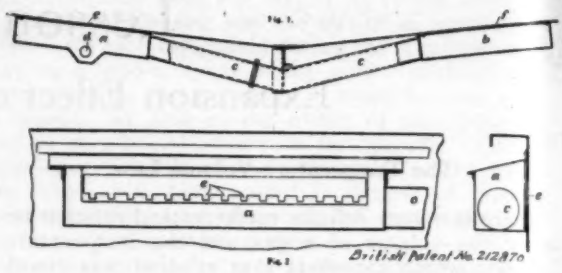
In calculating the change in volume brought about by temperature, the following rule should be followed, and if it is applied then there is no need of memorizing a formula:

If the new temperature is greater than the original, the original volume must be multiplied by a fraction whose numerator is greater than the denominator and whose terms are formed by adding 460 to the given temperatures. If the new temperature is less than the original, the original volume must be multiplied by a fraction whose numerator is less than the denominator. Rise in temperature means greater volume, fall in temperature means smaller volume.

CONSTRUCTION OF GAS HOLDER

There is provided near the top of the shell, and preferably along the outer wall surface, a number of comparatively long distributing tanks to which the liquid is permanently supplied by one or more pumps, and from which the liquid is allowed to issue by running over a long overflow, of which the overflow edge is closely recessed, so that the liquid may reach the inner walls of the shell in a great number of thin streams.

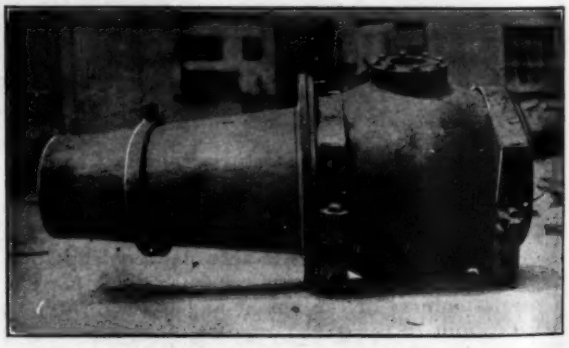
Fig. 1 shows an arrangement, in part-sectional plan view, of two distributing tanks at a joint between two adjacent wall panels of the gas holder shell, and Fig. 2 a longitudinal and a cross section. In these figures, a and b are the distributing tanks, in the form of elongated boxes communicating with each other by means of a pipe, c, which, in view of the viscosity of the sealing liquid, usually gas tar, has a large internal diameter. The liquid is introduced into the tank by means of one or more pumps delivering through a pipe d. Openings e and f are provided in the sides of the tanks and the walls of the gas holder shell through which the liquid may enter the latter, and the lower edges of these openings are recessed, for instance, castellated as shown in the drawing, so that the liquid will be caused to run down the inner wall of the shell in a large number of thin streams, which spread and thus provide the inner wall with a sheet or coating of downwardly flowing sealing liquid.



The provision of a sufficient number of distributing tanks around the shell and the action of the liquid collecting groove, which is usually provided around the circumference of the closing disc, ensure an even distribution and application of the liquid to the gap and, consequently, an effective gas-tight sealing of the variable gas space.—British Patent No. 212,870.

MAMMOTH GAS BURNER

The gas burner shown above is now installed and operating at the Riverside Portland Cement Company. According to the best information obtainable, this is the largest single gas burner which has ever been installed in the history of the gas industry. Its greatest diameter is approximately twenty-one inches. It burns six hundred cubic feet of gas per minute, and requires between five thousand and six thousand cubic feet of air per minute to produce a proper flame. This is the result of one of the experiments conducted by the New Business Department. It is used in a kiln where Portland cement is produced.



As The Journal Views It

THE COUNTRY'S BUSINESS AND INDUSTRIAL GAS

During the past few months general business conditions throughout most of the industries in the country have been,—to say the least,—rather bad. Depression has existed practically everywhere. In towns where several different industries operated, things have not been so bad as in certain others in which just a single industry was located. Thus, for example, in quite a few New England cities and towns where the principal industry was the manufacture of shoes or of textiles, the depression was most severe, because the shutting or slowing down of those plants practically put a stop to business.

While these conditions have been prevalent for the past few months, signs have appeared, indicating the coming of better times in the near future. It will not be very much longer before a decided improvement will have set in and prosperity will have made its appearance once again.

All this may be well known to the gas man, particularly to him who reads with care the news of the day and follows up industrial and economic affairs in the magazines devoted to those fields. What significance is there, however, in these vicissitudes of the general economic situation for the gas company and for gas men: what bearing do they have on the industrial side of the gas business?

Is there any lesson to be learned from the events that have taken place in the last few months? Is there any conclusion that can be reached in respect to the relation that exists between the gas company, as a manufacturer of gas for industrial purposes, and the general economic conditions of the country? Can some definite plan of action be devised based on these conclusions? In other words, and plainly speaking, what has all this got to do with the gas industry?

Not very long ago an eminent banker, whose business connections are largely concerned with the public utility field, made a statement in which he said that it was hard to believe that an industry in this country could be operated in the manner in which the public utility industries were, and we can apply this statement specially to the gas industry.

The economic conditions under which gas is sold are well known. The gas company is instructed how much to charge for its gas, and while it cannot get any less than this figure, neither can it get any more, unless the law is changed. Accordingly, the gas company earns what might be called a fixed income, which is calculated to be sufficient to pay the company's indebtedness and perhaps a fair dividend to its stockholders. There is no provision made for accumulation of a surplus. Wherever a surplus has been acquired, it has been in spite of the income.

Of course, the contention is that the gas business is a monopolized industry, and that people will use gas whether business is bad or good. For eat we must under all conditions and circumstances! Accordingly, our political friends, theoretical economists and others of like ilk argue that there is no need for a surplus, for the income will be always forthcoming.

This may have been true years ago. But since then conditions have changed and are still changing. The gas business can no longer depend entirely upon its domestic consumers for its income. It possesses industrial customers, and the proportion of industrial business is growing rapidly from year to year.

What is the result? Go into any of the smaller towns and cities in New England, or, in fact, in any part of the country, and ask the gas manager how his industrial business has been during the past couple of months. The answer will invariably be, "poor," except in a few cases where special circumstances existed to make it possible for the local industries to operate at full time.

Business has been bad, and the industrial gas customer has been forced to operate his plant at half time, or less. Under such conditions he did not require as much gas as when business was good, and not requiring it, he simply did not use it. The load on the gas plant was less; equipment had to be shut down for there was no need of operating it.

However, this equipment had to be in the best possible condition, for if the industrial customer suddenly secured a large order, he would want to start the plant at a moment's notice, turn on the gas and expect it to issue forth immediately.

It would not do to have to wait for the gas. It had to be there ready for use. This is as it should be. The gas plant must always be ready to furnish gas whenever it is wanted, but if it, like the other industries, has to bear the brunt of the hard times,—and it surely has, and will have to do so more and more in the future as its industrial business increases,—then it should be permitted, and in fact, it must be permitted properly to share in the good things that are available when times are good. In other words, it must be permitted to make sufficient income during prosperous times to tide it over the stretches when business is bad. In this it asks no more than any other industry.

This is the lesson that is to be derived from the recent depression in business conditions in this country. It shows clearly that the gas company is becoming more and more a purely industrial proposition which is affected by the economic situation, as well as other businesses. The assertion can no longer be made that the gas company will make money whether business is bad or good. If this is true, and every fair minded observer will agree that it is, then just like other businesses the gas company must have a reserve fund to fall back upon and to use under stringent business conditions. In other words, the gas company must be permitted to earn enough in good times so that it can accumulate a surplus fund which every business needs as an anchor to hold it safe and fast in stormy financial seas.

PRODUCTION OF SULPHATE OF AMMONIA

The recovery of coke-oven ammonia in the United States for 1923 easily surpasses all previous figures, amounting to 619,000 tons, according to the Geological Survey preliminary estimates. Even if we allow for a liberal deduction when the revised figures come in, as happened the year before, the amount will still exceed any previous mark. It is accounted for by the average operation of the coke plants in question at something over 85 per cent of their total maximum capacity (100 per cent) under the most favorable conditions. While such a performance may not occur again soon, it must be remembered that new ovens were under construction on January 1, 1924, that will add at least 10 per cent to the existing capacity, and that even in times of depression, recovery ovens are operated in preference to beehives because the latter stand shutting down better.

Ammonium Sulphate and Equivalent Recovered from Coal in the United States
(Net tons—2,000 lbs.)

	1913	1914	1915	1916	1917
Coke Oven	153,000	139,500	197,128	235,265	280,396
Coal Gas, Bone Carbonizing, etc.	42,000	43,500	52,921	53,000	45,274
Total	195,000	183,000	250,049	288,265	325,670
	1918	1919	1920	1921	1922	1923
Coke Ovens	348,654	373,223	469,463	328,500	449,232	591,000*
Coal Gas, Bone Carbonizing, etc.	30,624	30,000	30,000†	30,000†	27,529	28,000†
Total	379,278	403,223	499,463	358,500	476,761	619,000

*U. S. Geological Survey preliminary estimate.
†Estimated.

GAS RIPENS BANANAS

Old Sunlight Method Too Slow to Supply Demand

Large quantities of bananas are grown and ripened in the United States, and formerly the ripening process was so slow that often the demand exceeded the supply.

Gas, because of its ease of manipulation, is now used generally in the ripening process, supplanting the former sunlight methods, says the North and South Carolina Public Utility Information Bureau.

Bananas are hung in heating chambers, where gas burners distribute heat at regulated temperatures varying according to the ripeness of the fruit. Usually a temperature of about 80 degrees is maintained when the fruit is first placed in the chambers, and is then reduced as the bananas ripen.

Catechism of Central Station Gas Engineering in the United States

Installment No. 35

(Continued from Last Week.)

Deductions Drawn from the Analysis

If the analysis shows more than 6 per cent of sesqui-oxide of iron or 2 to 3 per cent of the lime, magnesia, etc., the brick should be rejected. But exposure of the brick to the action of heat under the conditions to which it will be subjected when used furnishes the best test for infusibility. In coal gas works the test can be made by placing the brick in the combustion chamber of a recuperative bench. If, when the brick is removed after being exposed for a week or ten days to the heat of the combustion chamber, the edges and the corners are found to be sharp, and the surfaces show no signs of incipient fusion, the brick may be passed as of first rate quality as far as infusibility is concerned. In water gas plants the space at the bottom of the superheater, in which the secondary combustion occurs, furnishes a good place for a test.

Effect of Compression of Brick

If the material of which the brick is made is well compressed during manufacture and the brick is hard burned, there is no question as to its strength when cold. The degree to which compression has been carried is indicated by the weight of the brick, and a fire brick of the regulation size, 9 in. × 4½ in. × 2⅝ in., should weigh from 7¼ to 7½ lb. A well burnt brick usually shows a reddish tinge. A well compressed and well burnt brick will give a ringing sound when struck with a hammer. It is especially important that the bricks which are to be used for lining the furnaces of retort benches, or for lining water gas generators, should be hard, since they are subjected to a great deal of abrasion from the fuel and the clinkering bars, so that for this work hardness and strength are of more importance than infusibility. In the combustion chamber, on the contrary, infusibility is the most important quality, since the material used there is not exposed to any wear and tear except that arising from the effect of the heat. It may thus frequently happen that the same brick is not suitable for use both in the furnace and in the combustion chamber.

Regularity of Shape and Uniformity of Composition

An examination of the exterior of the brick is all that is necessary to determine whether or not it possesses regularity of shape.

Uniformity of composition can be tested by breaking the brick and examining the surface of the fracture. This should present a compact and uniform appearance, though not necessarily a close and fine texture. In fact, some authorities consider a coarse texture to be preferable. Uniformity of composition is also indicated by the giving out of a clear ringing sound when the brick is struck a sharp blow with a hammer.

Facility of cutting is important only as reducing the cost of labor and the amount of waste during the operation of laying the brick, and while desirable, if it can be secured without sacrificing the more important qualities, it cannot be considered an equivalent for any one of them.

What Is a Paint and a Varnish?

195. What is a paint? What is a varnish?

Ans. Technically, a paint is a mechanical mixture of a liquid (generally linseed oil, with turpentine known as the "vehicle") and a finely divided solid (as white lead or red oxide of iron, known as the pigment, or coloring substance), sufficiently fluid to be applicable to surfaces with a brush, and having the property of drying upon surfaces coated with it to a hard, continuous, tenacious and somewhat elastic skin, protecting them from air and moisture, and giving them the color of the pigment used.

Paint acts, therefore, as a preservative and a decorative covering.

The pigment in its dry state is also called "paint."

An oil, or mixture of oils, to be valuable in a paint, should have the property of drying when applied to a surface, to a hard, lustrous and tenacious skin.

Water is sometimes used as the vehicle of paint. A simple mixture of water and a pigment does not adhere to surfaces with the tenacity of oil paints.

A varnish is a solution of a resinous substance (as amber, copal, shellac, etc.) in an oil or spirit (as linseed oil, turpentine, alcohol, or methylated spirit), which will dry and harden, and remain transparent. When the solvent is an oil, the varnish is known as an "oil varnish." When the solvent is a spirit, the varnish is known as a "spirit varnish." Varnishes, when applied to wood, metal or other surfaces, dry and form a hard, smooth, transparent, and somewhat elastic surface, protecting the material covered from the air and moisture. Varnishes may be colored by the addition of substances that give color without making the mixture opaque.

(Note: The following section on photometry is reprinted as it appeared in the original Catechism in order not to break the continuity of the book, although the information given is not as useful now as when the book was first published.)

The Units Employed in Photometry

196. What is the unit used in Great Britain and America for measuring and expressing the illuminating value of gas, and what is the value of this unit?

Ans. The unit used in Great Britaia nnd America for measuring and expressing the illuminating value of gas is the "candle power.' The literal meaning of "candle power," as a measure of illuminating value, is the amount of light given by the flame of a candle. It is, however, evident that the flames of different candles give different amounts of light, and therefore, to obtain an amount of light that shall be as nearly as possible a definite and unvarying quantity and fit to be used as a unit of measurement, it is necessary that the candles employed should be made and burned in accordance with certain rules. Candles so made and used are called standard candles.

It is also evident that after having obtained a standard candle, before any deductions can be made as to the comparative candle powers of different gases as obtained by separate observations, it is necessary that the rates at which, and the burners in which, the gas is consumed must be uniform, since the same gas consumed at different rates in one burner, or at the same rate in different burners, will give different amounts of light. Therefore, the term "candle power" implies the use of a standard candle burning at a definite rate and of a standard burner and rate of consumption for the gas.

Definition of the Standard Candle

The standard candle is a sperm candle of six to the pound and is burnt at a rate of 120 grhins of sperm per hour. For a long time these general requirements were the only ones that had to be met, but wide variations in the amount of light given by different candles, all of which fulfilled the above requirements, led the London Gas Referees to adopt regulations for securing uniformity in standard candles, which prescribe the method and materials to be used in the manufacture of the wicks and the melting point of the spermaceti that are to be employed in making such candles. In the absence of any regulations on the subject in this country, it is well to see that the candles used fulfill as nearly as possible the requirements of the Gas Referee. These rquirements are given in full in the answer to question No. 197.

Standard Rate Burner

The standard rate of consumption for the gas is 5 cu. ft. per hour. The form of burner used as the standard varies with the locality and the nature and the quality of the gas to be tested. In England, for the testing of coal gas of from 14 to 16 candle power, the burner originally prescribed by law for use as the standard burner was a special form of Argand burner known as Sugg's London Argand No. 1. In 1906 a new standard burner known as the Metropolitan Argand No. 2, or the Carpenter burner, was adopted as the standard for London and is being rapidly adopted all over Great Britain. For cannel gas of from 20 to 26 candle power a flat flame burner is commonly prescribed as the standard. In this country the No. 7 Bray Slit Union burner has been very generally adopted as the standard burner, especially where the gas to be tested is either a carburetted water gas or a mixture of this gas with coal gas. The London Argand is also used in many instances for coal gas. The New York Commission of Gas and Electricity has recently made regulations for the testing of gas in New York State, which provide that the tests of illuminating power shall be made with either a new style F Argand burner, old style D Argand burner or No. 7 Slit Union Bray burner, as may be best suited to the gas tested. It is always necessary to note what burner has been employed as a standard in each case before any comparison can be made between the reported candle powers of the gases supplied in different localities.

From what precedes it is seen that when it is said that a gas is of a certain candle power the idea intended to be conveyed is that the gas will, when burned in a standard burner at the rate of 5 cu. ft. per hour, produce a flame which gives a light equal to that given by a certain number of standard candles, each consuming 120 grains of sperm per hour.

Meaning of Candle Power

197. What is the meaning of "candle power" in the statement "this is a 20 candle power gas?"

Ans. The words "candle power" in the statement "this is a 20 candle power gas," are used to denote the amount of light given by the flame produced when any gas is burned in a standard burner at the rate of five cubic feet per hour, expressed in terms of a unit, which is the amount of light given by a standard sperm candle of six to the pound burning at the rate of 120 grains per hour. The statement "this is a 20 candle power gas" is, therefore, a statement that the gas named will, when burned in the standard burner at the rate of five cubic feet per hour, produce a flame giving an amount of light twenty times as great as that given by a standard sperm candle of six to the pound burning at the rate of 120 grains per hour.

Forms of Burners Used

Different forms of burners are used in different localities as the standards for the purpose of determining the candle power of gas. In England, when the gas to be tested is a coal gas of from 14 to 16 candle power, the burner formerly generally prescribed by law for use as the standard burner is a special form of Argand burner known as Sugg's London Argand, No. 1. Since 1906 another form of Argand burner, known as the Metropolitan No. 2 or Carpenter burner, has been largely adopted as the standard burner to be used in determining the illu-

minating value of gas of the quality named above. For cannel gas of from 20 to 26 candle power a flat flame burner is commonly prescribed as the standard. In the United States the No. 7 Bray Slit Burner has been very generally adopted as the standard burner, especially where the gas to be tested is either a carburetted water gas or a mixture of this gas with coal gas. The London Argand is also used in many instances for coal gas, being specified by the Gas Commissions of Massachusetts and the Second District of the State of New York. It is always necessary to note what burner has been employed as a standard in each case before any comparison can be made between the reported candle powers of the gases supplied in different localities.

Specifications of the Candles

As far as the candles are concerned the only qualifications generally adopted are that they shall be sperm candles of six to the pound and shall be burnt at the rate of 120 grains per hour. Wide variations in the amount of light given by different candles, all of whlch fulfilled the above requirements, led the London Gas Referees to adopt regulations for securing uniformity in standard candles which prescribe the method and materials to be used in the manufacture of the wicks and the melting point of the spermaceti that are to be employed in making such candles. In the absence of any regulations on the subject in this country it is well to see that the candles used fulfill as nearly as possible the requirements of the Gas Referees.

Details of Requirements

These requirements, as given in Butterfield's' Chemistry of Gas Manufacture, are as follows:

"Regulations for Securing Uniformity in Standard Candles.—1. The wicks shall be made of 3 strands of cotton plaited together, each strand consisting of 18 threads. The strands shall be plaited with such closeness that when the wick is laid upon a rule and extended by a pull of about 1 ounce, just sufficient to straighten it, the number of plaits in 4 inches shall not exceed 34 nor fall short of 32.

"Each wick shall be of suitable length, not less than 12 inches, and looped ready for fixing in the mould. After having been bleached in the usual manner and thoroughly washed, the wicks shall be steeped in a liquid made by dissolving 1 ounce of sal-ammoniac and 1½ ounces of crystallized boracic acid in a gallon of distilled water; they are then to be gently wrung or pressed till most of the liquid has been removed, and dried at a moderate heat while lying horizontally.

"Such a wick cut to a length of 12 inches, when stretched as above, shall weigh not more than 7 nor less than 6 grains. The weight of the ash remaining after the burning of 10 wicks which have not been steeped in boracic acid, or from which the boracic acid has been washed out, shall be not more than 0.03 grain.

Wicks made in accordance with this prescription shall be sent to the office of the Gas Referees, by whom they will be examined and certified.

"The wicks so certified are to be used by the candle-maker in the condition in which they are returned to him.

"When the wicks are set in the mould, they should be pulled with only so much force as is necessary to straighten them.

The Spermaceti

"2. The spermaceti of which the candles are made shall be genuine spermaceti, extracted in the United Kingdom from crude sperm oil, the product of the sperm whale (Physeter macrocephalus). It shall be so refined as to have a melting point lying between 112 deg. and 115 deg. F. An account of the method by which the melting point of the spermaceti is to be determined is given later.

"Since candles made with spermaceti alone are brittle, and the cup which they form in burning has an uneven edge, it is necessary to add a small proportion of beeswax or paraffin to remedy these defects. The best air-bleached beeswax, melting at or about 144 deg. F., and no other material, shall be used for this purpose, and the proportion of beeswax to spermaceti shall be not less than 3 per cent nor more than 4½ per cent.

"3. The candles made with the materials above prescribed shall each weigh, as nearly as may be, 1/6 of a pound, and will be found to answer to the following test: Immerse a candle taper-end downwards in water of 60 deg. F., with a brass weight of 40 grains attached to the wick by a small piece of thread; when a further weight of 2 grains is laid on the butt end of the candle it will still float, but with a weight of 4 grains it will sink.

"The candles shall be sent to the office of the Gas Referees, by whom samples from each batch will be examined and tested. Each batch of candles shall be accompanied by a specimen of the spermaceti (unmixed with beeswax) which was used in making them.

Method of Washing Wicks

"Method of Washing Wicks.—As it is found to conduce to the regular burning of candles that the wicks should have been as fas as possible cleaned and freed from mineral matters, it is recommended that the candle-maker, before steeping the wicks, shall wash them first in distilled water made alkaline with between 1 and 2 per cent of strong liquid ammonia, then soak them for several hours in dilute nitric acid containing about 10 per cent of strong acid, and finally wash them in distilled water made alkaline with a few drops of ammonia.

Melting Point of the Spermaceti

"Method of Determining the Melting Point of the Spermaceti.—As various methods are used by different refiners of spermaceti for determining the melt-

ing point, which lead to different results, it must be noted that the temperatures here given as the limits within which the melting point of a sample of refined spermaceti should fall—viz., 112 deg. and 115 deg. F. —have been found by the following method, which is known as the capillary-tube method:

The Capillary Tube Method

"A small portion of the spermaceti is placed in a short test-tube, and melted by plunging the lower end of the tube in hot water. A glass tube drawn out at one end into a capillary tube about 1 mm. in diameter is dipped narrow end downwards into the liquid spermaceti, so that, when the tube is withdrawn, 2 or 3 m., of its length are filled with spermaceti, which immediately solidifies. The corresponding part of the exterior of the tube also becomes coated with spermaceti, which must be removed.

"The narrow part of the tube is then immersed in a large vessel of water at a temperature not exceeding 110 deg. F. The lower end of the tube, which contains the spermaceti, should be 3 or 4 inches below the surface, and close to the bulb of a thermometer. The upper end of the tube must be above the surface, and the interior of the tube must contain no water. The water is then slowly heated, being at the same time briskly stirred, so that the temperature of the whole mass is as uniform as possible. When the plug of spermaceti in the tube melts, it will be forced up the tube by the pressure of the water. The temperature at the moment when this movement is observed is the melting point."

Using the Standard Candles

198. Describe the way in which standard candles should be used and handled, when making a photometric test, to make them yield the proper amount of light when burning at the specified rate of 120 grains per hour.

Ans. When candles are used as the standard of light in making a photomeric test, the first precaution to be taken is to be certain that the candles are standard candles. It is necessary to depend for this upon the reputation of the manufacturer by whom the candles are made. The long candles, that is, those from 8¼ in. to 9 in. long measured from the shoulder, give, as a rule, more consistent results than do the short ones.

All modern candle balances are made to take two candles at a time, as the use of two flames instead of one throws the position of equal illumination of the two faces of the disc nearer the middle of the bar where slight errors in setting make the least difference in the readings, and also neutralizes any variations from the normal in different parts of the candle.

Preparing Candle for Use

To prepare a candle for use, the conical tip should be cut off even with the shoulder and the end of the candle so left made perfectly square with the axis, so that the candle will stand vertically when placed on its end. It should then be cut in two as nearly as possible at the middle point between the shoulder and the bottom, and then ½ in. of the sperm should be separated from the top of the lower half and the bottom of the upper half. When separating these pieces care must be taken not to injure the wick, and on this account it is advisable to take each off in one piece, by cutting carefully through the sperm at the right distance from the end of the half candle and pulling off from the wick the piece of sperm so separated. Each of the halves should now be lighted in such a way that the sperm at the base of the wick is melted at the same time that the wick is lighted so that the flow of the sperm up the wick will begin at once. This, by preventing the burning away and charring of the wick, reduces the length of time required by the candles before they settle down to their normal condition and rate of burning. When new candles are first lighted it is well to hold them in a horizontal position and revolve them a few times around the wick as an axis, to melt off some of the sperm and burn off any ragged edge that might be left on the wick, but with candles that have been used before, all that is necessary is to melt the sperm at the base of the wick when lighting them.

Burning the Candles

The candles should be allowed to burn at least twenty minutes after being lighted before the test is made, to render it certain that they have reached their proper condition. The instructions usually given are that they should be lighted at least ten minutes before making a test, so as to allow them to reach the normal rate of burning, but unless they are in the proper condition the light given may vary

Fig 1.

Fig. 2.

considerably, even when the consumption of sperm is normal. The attainment of the proper condition can be determined by the appearance of the wick and the top of the candle. "The wick should appear compactly woven and not bent to an exceeding degree out of the upright," and the tip should glow and remain just within the edge of the flame, while the cup at the top of the candle should be well defined and dry. The proper degree of curvature is shown on Fig. 1.

(Thirty-sixth Installment Next Week)

THE FUEL OF THE FUTURE—WHAT SHALL IT BE?

(Continued from page 790)

Consumption of Natural Gas in Industrial Operations

The following tabulation, which is taken from American Fuels by Bacon and Hamor, gives the consumption of natural gas in various industrial heating operations. The natural gas in question is of average calorific power:

TABLE II

Nature of operation	Cu. ft. of gas used
Window glass, per box, single strength glass	1,700
Window glass, per box, double strength glass	2,500
Melting aluminum, per 100 lbs. metal	283
Nut furnaces, per 100 lbs. of nuts made	193 to 245
Bakers' ovens, per 100 lbs. dough baked	126
Lead melting, per 75 lbs. of metal melted	1,000
Ice making, per ton of ice made	6,000 to 7,300
Flour mill power, per bbl. flour made	275 to 300
Cotton gins, per bale of cotton ginned, average per season	2,400
Open hearth steel, per ton metal	6,400
Brass melting, per 650 lbs. metal melted	1,100
Gas engines, per indicated horsepower	9 to 11
Biscuit tile, per ton biscuit tile made	20,000
Sewer pipe, per ton pipe made	11,800

Before leaving the subject of natural gas, attention must be called to the practice, which is generally becoming more and more prevalent, of mixing natural gas with manufactured gas in order to conserve the supply of the former. In many parts of the country which are now supplied by natural gas this has been found necessary, and it is safe to say that in the future, when supplies of natural gases are further reduced, more and more artificial gas will be employed for this purpose.

Producer Gas

Producer gas is at the other extreme of the list of industrial gases as far as calorific power is concerned, for producer gas possesses lower heating value than any of the gases commonly used for industrial heating purposes. It is also the cheapest gas that can be made from solid fuel per B.t.u. obtained.

Producer gas is the gaseous fuel that is obtained when air is blown through a mass of incandescent carbon. One pound of carbon in coal will yield on the average 14,600 B.t.u. of heat when burned completely to give carbon dioxide. This is the total heat energy that it contains. On the other hand, it can be burned in deficiency of sufficient air to produce complete combustion to give carbon monoxide with a consumption of only 4,400 B.t.u. of heat. This leaves approximately 10,200 B.t.u. in the gas obtained from its combustion under these conditions. The product of incomplete combustion is carbon monoxide, CO. This is the principal constituent of the commercial gas which is commonly called producer gas, or air gas.

The Producers

The apparatuses in which the gas is manufactured are known as producers, and there are many different types of producers in commercial operation today. The variations in the design of the producers are concerned with arrangements for blowing in the air, arrangements of special grates for burning all sorts of low grade fuels, not only the cheapest soft coals, but also lignite coal, wet peat, wood refuse, garbage and all sorts of waste carbonaceous materials, and other changes in construction of minor importance.

The coal is piled into the producer and is burnt while air is blown through the bed. Generation of producer gas takes place in different parts of the coal layers. The coal bed is commonly divided into three zones. The top zone is known as the distillation zone in which the volatile matter of the fuel is driven off by the heat from the gases, which pass up through it from the lower zones. The intermediate zone is known as the reduction zone in which carbon dioxide in the gases from the lowest zone is reduced to carbon monoxide at the expense of the fuel, in accordance with the equation:

$$CO_2 + C - 2CO_1$$

This results in the formation of a certain percentage of carbon monoxide, a heat-producing ingredient of the gas. The reaction is of considerable importance and conditions must be arranged in the producer so that it takes place.

The Reduction Zone

This involves the second phenomenon which takes place in the reduction zone of the producer. The reaction between the carbon of the coal and the carbon dioxide in the gas coming up from the lower layer of coal in the producer is endothermic in character, that is, it consumes heat, or, in other words, heat is necessary to bring the reaction about. Hence, whenever it does occur, the natural result is a reduction in the temperature of the reduction zone, due to the consumption of heat in the reaction. The heat that is taken from the reduction zone is, of course, stored as potential heat energy in the carbon monoxide gas, to the amount of 340 B.t.u. per cubic foot of the gas. In order that conditions are suitable for the reduction of carbon dioxide to carbon monoxide, it is necessary that the temperature of the fuel bed in the reduction zone be in the neighborhood of 1600 degrees F.

The Combustion Zone

The lowest zone in the producer, which lies just above the layer of ash covering the bottom of the apparatus and the tuyere through which air is blown, is the combustion zone. The layer of ash is

present to prevent the burning out of the tuyere and also so as to distribute the blast of air uniformly throughout the coal bed. The amount of air that is permitted to enter the combustion zone is limited, so that incomplete combustion takes place in accordance with the following equation:

$2C + O_2 = 2\ CO$ or $3C + 2O_2 = CO_2 + 2\ CO$.

Incomplete combustion of the coal leads to the formation of carbon monoxide. It is, of course, impossible to stop a certain amount of carbon dioxide from being formed in conjunction with carbon monoxide, in accordance with the second of the above equations, but the dioxide is eventually reduced anyway by coming in contact with the hot carbon in the reduction zone, as has been explained.

The nitrogen that is mixed with the air that is blown into the producer is inert and takes no place in the reaction. It is the diluent of producer gas and as there are four times as much nitrogen by volume in air as oxygen, it readily explains why the calorific power of producer gas is so low. Nitrogen actually forms about half of the percentage by volume of producer gas.

The Use of Steam in Producers

A word must be said about the use of steam in producers and the effect of the same. The explanation of the reaction that takes place really belongs to the section on water gas, for this reaction was first applied commercially in the manufacture of this gas.

Producer gas need not be produced with steam from a theoretical standpoint. But difficulty in practical operation of the producers made it necessary to do something that would tend to lower the temperature within the combustion zone. The heat developed therein was found to be so great that the ash fused, clinkering resulted and the operation of the machine was seriously interfered with. Hence, the reaction which is the basis of the water gas process was employed to consume part of the excess heat.

When steam is brought into contact with hot, incandescent carbon a reaction takes place which reduces the heat of combustion and results in the formation of a mixture of carbon monoxide and hydrogen. Thus, the introduction of steam into the producer is not only advantageous from the standpoint of avoiding serious difficulties in the operation of the producer, but also from the standpoint that it adds constituents to the gas which possess heating value and which raise the calorific power of the same. However, it must be remembered that the use of steam in the producer is practised just for the purpose of maintaining the proper temperature within the combustion zone of the coal bed, and not to produce constituents of heat value and enrich the calorific power of the gas.

It has been suggested that carbon dioxide be used for the same purpose, the results being the same as the dioxide would be reduced to the monoxide by the hot carbon with reduction of the temperature within the combustion zone, but it has been found more practical to use steam.

The Types of Producers

As has been mentioned, there are numerous types of producers, but space prohibits their description at this point. The variation in the design of the producers is not so much in the fundamentals of the apparatus as in the manner in which the draft is applied, in the nature of various mechanical improvements, such as method of agitating the fuel bed, mechanical charging of the coal, removal of ash and clinker, etc.

The Fuels Used

A wide variety of fuels can be used in the producer and of course the quality of the gas manufactured depends to a large extent on the nature of this fuel. Almost any kind of waste carbonaceous material can be employed. Similarly, the highest grade fuels can be used. Thus charcoal is probably the best producer fuel, because it possesses only a small amount of tarry matter and is very easily handled in the machine. But it is prohibitive because of its price. Anthracite coal is also a very good producer gas fuel, but here again the cost is too high for common application.

Coke is also a very good fuel for making producer gas. The tarry matter that is derived from coke is very small in amount, but this tar has been found more difficult to handle than the tar obtained from soft coal. Peat and lignite are also possible producer fuels, but their use introduces certain factors, such as the removal of the water content of the fuel and the difficulty of getting the lignite to the producer plant. Up to the present time no great progress has been made in this country with these fuels.

Soft coal, because it occurs in such large quantities and because it is so widely distributed throughout the country, making it the cheapest solid fuel in most localities, is the leading producer fuel. Nevertheless, there are serious difficulties encountered in its use, due particularly to the possible fusing of the ash, the formation of impurities which are mixed with the gas, all of which are subject to considerable variation due to the different compositions of the soft coals.

Purification of the Gas

The fact that by far the greater amount of producer gas is manufactured from soft coal and that the manufactured gas contains various impurities which may or may not have a detrimental effect on the products that are made with its aid renders it necessary in most cases to purify the gas. This fact also limits its applicability and opens up the field to central station gas, even though the latter may cost more.

After all, it must be remembered that the manufacture of gas is a distinct branch of chemical and mechanical engineering. The average manufacturer has enough to do to watch the details of his particular manufacturing process without manufacturing

gas as well. Furthermore, the cost of the gas will not be so low as expected when all charges are made against the installation, and particularly if the producer plant is operated with poor efficiency. All these conditions mitigate against its wide application in industrial plants. On the other hand, there is no question that in very large establishments which use enormous quantities of gas daily, such as steel mills and the like, producer gas has found a definite field and is the cheapest fuel that can be employed for the purpose. Furthermore, it must be borne in mind that in these uses of producer gas it is unnecessary to purify the gas before employing it, which is a very decided advantage.

The cleaning of the gas is just as involved and technically difficult an operation as the purification of coal gas or water gas. Besides, it possesses certain peculiarities of its own.

Composition of Producer Gas

As has been said, the composition of producer gas varies in accordance with the raw materials from which it is manufactured, the conditions under which this manufacture is carried on and the treatment that the gas receives after it is made. In the following table a few analyses of typical producer gases are given. It is easy to see how the gas varies in composition.

	Volumetric Analysis							Ratios	
Description	CO	H_2	CH_4	Heavy hydrocarbons	CO_2	O_2	N_2 and remainder	$\frac{CO}{CO_2}$	$\frac{CO}{CO_2}$
From sawdust in Switzerland....	29.8	6.5	6.9	0.30	6.00	....	50.5	4.97	0.833
Producer gas, little steam.....	28.8	13.47	0.10	...	6.20	0.2	51.23	4.65	0.824
Producer gas from anthracite coal, little steam	28.00	4.0	4.0	...	4.00	....	60.00	7.00	0.875
Peat gas	27.2	0.9	3.10	...	12.10	....	56.7	2.25	0.692
Producer gas from American bituminous coal	26.97	13.00	0.33	...	4.37	0.21	55.12	6.17	0.86
Producer gas, anthracite, up draft	25.70	13.30	0.20	...	5.50	0.40	54.9	4.67	0.824
Producer gas from coke fuel, Adams, complete test.....	25.5	12.0	0.40	...	5.30	0.65	56.15	4.81	0.828
Dowson producer gas, Thorpe....	25.07	18.73	0.62	...	6.57	....	49.01	3.82	0.79
Producer gas, bituminous coal, down draft	24.80	8.50	1.00	0.10	4.10	0.10	61.40	6.06	0.859
Producer gas from German lignite	23.99	10.64	0.25	...	5.21	0.63	59.28	4.60	0.821
Producer gas	22.00	15.87	...	...	7.60	0.20	54.33	2.89	0.74
Producer gas from lignite.....	20.20	25.00	...	...	6.60	2.20	46.00	3.06	0.754
Producer gas from anthracite.....	16.60	24.20	2.00	...	11.30	...	45.90	1.47	0.595
Producer gas from bituminous coal	13.20	24.80	2.30	...	12.90	...	46.80	1.030	0.506
Producer gas from bituminous coal, much steam	11.00	27.50	2.00	...	16.50	...	43.00	0.666	0.4
Producer gas from German brown coal lignite	8.10	24.30	16.50	1.40	17.00	3.10	29.16	0.475	0.323

It will be remarked that the composition of the producer gases is arranged in accordance with the decreasing percentage of carbon monoxide that they contain. It is seen that there are gases scattered throughout this table that are made from the same raw materials. Thus, an anthracite coal under certain conditions will give a producer gas containing 28.00 per cent of carbon monoxide and under certain other conditions the percentage of carbon monoxide in the gas, when anthracite is again used as fuel, is reduced to 16.60 per cent. The variation in the composition of the gas is accordingly very great, and it depends not only on the fuel that is used, but also on the manner in which the producer is operated.

The Use of Producer Gas in Industry

It has been shown that producer gas contains little concentration of heat values; in other words, a large volume of gas is necessary to produce a heating effect in comparison with manufactured central station gas. Hence it would not pay to transport this low calorific power gas from a place at which it was manufactured to the point at which it is used. It lends itself, however, to production at the spot at which it is going to be used.

At the present time producer gas is used largely in the steel industries for firing open hearth furnaces, soaking pits, etc. It is also used to some extent in large glass plants and zinc refineries. It has also been employed in the automobile industry for the heat treatment of parts. Another use is in drop forging work.

But there is no question that the average sized manufacturer will find it to greater advantage to purchase the gas he needs for his processes than to maunfacture the gas itself. The operation of a producer is not a simple affair and it must be given considerable care and attention if good results are to be

obtained. The industrial gas engineer may find certain cases in which he cannot introduce the use of manufactured central station gas as an industrial fuel, but these will be special in nature. In the majority of instances he will find no opposition to the use of his gas as fuel, but rather a limited knowledge of the entire fuel situation and a reluctance to abandon the coal-fired furnace for that of the gas-fired, whether the gas be natural gas, or producer gas, or central station gas.

RELATIVE VALUE OF FUEL

(Continued from page 792)

But the respective efficiencies of fuel in the production of heat must be taken into account.

Let A represent the cost of 1,000 c. f. coal-gas in cents, say $1.00

Let B represent the cost of one ton of coal in cents, say $13.00

Let C represent B. T. U. in 1,000 c. f. coal-gas, say 600,000

Let D represent B. T. U. in one ton coal, say 26,000,000

Let E represent the efficiency of utilization of gas, say 25 per cent

Let F represent the efficiency of utilization of coal in kitchen ranges, say 7 per cent

Let X represent the relative value of fuel

$$X = \frac{A \times D \times F}{B \times C \times E} = \frac{100 \times 26{,}000{,}000 \times 7}{1{,}300 \times 600{,}000 \times 25} = \frac{182}{195} = 0.935$$

or nearly equal.

If, however, we take the case of a manufactory, the interest on capital invested on the heating plant, the cost of operation, the quality and production of manufactured commodity, and other factors have to be considered to arrive at the relative cost of these two fuels, which result will doubtless be to the credit of coal-gas.

IDEAS OF INTEREST TO THE MAN WHO SELLS

(Continued from page 793)

true if you are close to your source of supply.

You also want to bear in mind that if you have large stocks, in which you have tied up your money, and you have a sudden demand for ready cash, the only way to realize it on your stock is to take a heavy mark-down.

That is the way the good merchandiser views it.

A Bed-Time Story

We were seated in the office of the advertising manager of a large Philadelphia jobbing house one day when a card was handed in. "All right," said the advertising man, "show him in. No," as we went through the motions of leaving, "just keep your seat; it's a fellow from the telephone directory people, and I want to talk to you a while yet." We remained seated and the man was shown in and after greeting him our friend proceeded thus: "You don't want any directory advertisement, do you, Mr. Blank?" and before he had time to say another word our friend came back at him with this reply, "Why, no—I don't, but how did you know it?" Here, needless to say, the interview ended. The salesman for the directory company had used all his ammunition in one poor shot, and all there was left for him to say was good day.

This same sort of threadbare, meaningless greeting is losing many, many sales in all lines of retailing today. "Is there something for you?", "What's yours?" or "Yesser" have the same effect on the prospective customers as "You don't want a gas range, do you?" If we can't think of anything else to say as we approach a visitor to our store, we can at least say, "Howdy," and get away from the "Don't want" phraseology. The mere fact that they have entered our store should tell us they had a purpose. Let's serve them.

Have You Started Your Home Service Work?

A lot of folks figure it is too hot to start anything in hot weather, and when the weather man sends the first cold blast of winter they will figure it is too cold. That's the way the thing goes, and it is largely this same class that say, "Well, it's bound to be dull in June, July and August; furthermore, business is never good during a Presidential year." But, on the other hand, there are to be found, here and there, merchandisers who say, "Well, business is as good as we make it," and it is of these merchandisers that we have something to say.

The Laclede Gas Light Company, St. Louis, is going after things in a big way and has recently built in a Home Service Window in the main store and is employing all the salesmen it can find who can make the grade in the Merchandising School conducted by the company. Down in Augusta, Ga., the Gas Light Company recently built a Home Service Window (Model Kitchen) at an expense of several hundred dollars, while the other four properties of the Southern Gas & Power Company, Bluefield Gas & Power Company, Bluefield, W. Va., the Concord & Kannapolis Gas Company, N. C., the Gastonia & Suburban Gas Company, N. C., and the Suffolk Gas & Electric Company, Va., are all building Model Kitchens.

Mrs. S. R. Dull Demonstrates

That the home manager is interested in improved cooking methods is being well demonstrated by Mrs. S. R. Dull of Atlanta. Recently Mrs. Dull conducted a cooking class at Greenville, S. C., that was a record-breaker.

There were five classes, with attendances as follows: Monday 262, Tuesday 283, Wednesday 302, Thursday 318 and Friday 417. During the five days Mrs. Dull used both the standard cabinet range and the standard cabinet range with oven heat control, and while she demonstrated how different foods are cooked every day, including the baking of two hams, she also demonstrated that "where heat is required, you can do it better with gas"—and more economically, for only 63 cents worth of gas was used during the five demonstrations.

Another "Cooking Test" that attracted considerable attention was that recently held by the Concord & Kannapolis Gas Company, Concord, N. C. Here, too, economy was the keynote and the fireless type of range was used. The theme of the campaign was "Cut Your Gas Bill in Half."

All of these demonstrations are profitable, for they bring folks into the store who otherwise would never visit it. A number of people who do not use gas and who secure their first ideas as to the value of gas service and gas appliances are also reached in this way. It is the writer's belief that more and more "store selling" will be done by the gas company, as time goes on, and that when a salesman is sent into the home of the customer, he will be "sent on request" or to "render service" not as a canvasser.

SELLING RANGES IN A SPECIAL SALE

(Continued from page 794)

showing all the salient features and advantages of the type of ranges offered for sale, as well as some of the tempting viands which had been prepared by attractive maidens in the store, and cooked upon the ranges used as demonstrators.

These show windows, one upon either side of the store entrance, may be given due credit for their share in promoting the success of the sale, and their completeness and appropriateness, in relation to a scientific exhibition of the salient features of the wares for sale within, were remarked by thousands of persons who daily passed the store. At almost any hour of the day, during these two weeks, a large group of interested spectators might be seen in front of the two windows, studying the displays with care, and commenting with interest upon the specific features of these displays.

The Added Display of Gas Heaters

Another feature of great value in attracting the attention of passersby, and a feature not peculiar to this sale, but in use during the greater part of the year, was the display of two gas heaters, one upon either side of the store entrance.

These heaters are so constructed as to throw their heat outward in a very "convincing" manner, and thus each pedestrian passing was given two sharp "whiffs" of gas heat, upon passing the two stoves. Naturally, it caused them to glance involuntarily toward the stoves, and from the stoves to the windows. The efficiency of this method of drawing attention to the show windows cannot be doubted, at least by anyone who passed by the stoves, and who experienced the whiff of heat. These two stoves were kept burning 24 hours a day, during the months in which they were used as advertising mediums.

Newspaper advertising was used freely during the sale, and should be given its full degree of credit in bringing customers to the store. But the "terms" and the selling plan were perhaps the greatest contributing factors, which resulted in the sale of almost 1,000 gas ranges during the comparatively short period of two weeks.

ADVERTISING—THE DUTY OF A MONOPOLY

Advertising is not only a wise policy on the part of public utilities, but it is actually a duty both to customers and stockholders, according to a resolution adopted by a meeting of the Public Utilities Advertising Association held during the recent convention of the Associated Advertising Clubs of the World.

The resolution was presented by F. W. Goodenough, executive chairman of the British Commercial Gas Association, who presided over the meeting jointly with an American representative, Frank LeRoy Blanchard, of Henry L. Doherty & Company, New York, and read as follows:

This conference is of opinion:

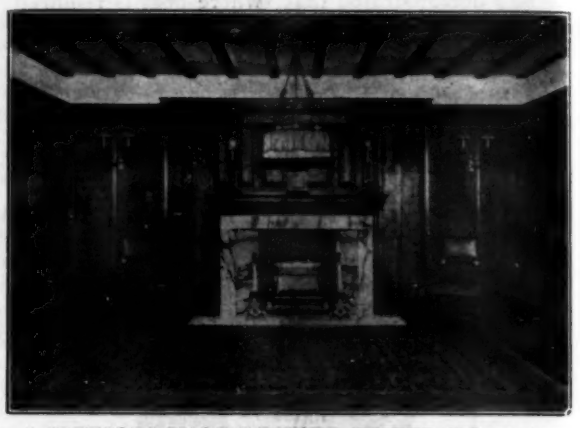
1. That it is as important to advertise the services which public utilities can render to the community as it is to advertise the goods of firms which have no monopoly rights of supply;
2. That goodwill, based upon equitable policy and "service first" principles, is essential to the permanent prosperity and persistent progress of public utility undertakings;
3. That advertising is essential to the establishment and maintenance of such goodwill;
4. That fully educated, efficient salesmen are equally essential; and
5. That the possession of a monopoly, whether by a company or a municipality, imposes on its administrators the duty of a policy of progressive business methods, in the interests of consumers as well as of stockholders.

Gas for Lighting and Cooking

A few examples of artistic installations in fine homes in England

A MODERN ALL-GAS KITCHEN

By means of the apparatus here shown the food is cooked, the kitchen warmed, the refuse destroyed, and all the hot water which may be required throughout the house heated. (The gas fired refuse destructor is shown under the draining board.)

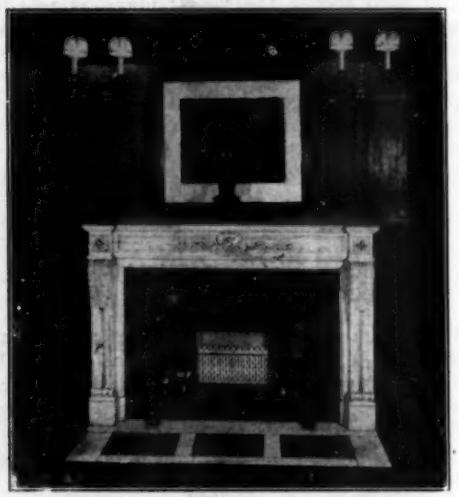


A "PERIOD" HALL LOUNGE FITTED WITH A GAS FIRE

The lounge is lighted by a silk-shaded pendant, with inverted incandescent gas burners, while the paneling is displayed to advantage by shaded gas candles with brackets.

EXCELLENT LIGHTING EFFECTS WITH GAS

Obtained by semi-indirect lighting pendants fitted into silk-shaded inverted gas burners. The fireplace is fitted with an old dog grate adapted for use with gas.



GAS IN AN ANTIQUE FIREPLACE

The modern gas fire and candle wall brackets with incandescent gas burners have been admirably chosen to harmonize with the paneling.

Current Market Prices

COALS (By Courtesy of Coal Age)

A. Bituminous.

(Spot prices, F. O. B., mines, net tons).

High Volatile, Eastern	Market	Price
Pool 54-64 (Gas Standard)	New York	$1.35 to $1.65
Pittsburgh screened gas	Pittsburgh	2.30 to 2.50
Pittsburgh gas, mine run	Pittsburgh	2.00 to 2.25
Kanawha lump	Columbus	2.00 to 2.25
Kanawha mine run	Columbus	1.30 to 1.55
West Virginia lump	Cincinnati	1.85 to 2.25
W. Virginia gas mine run	Cincinnati	1.40 to 1.60
Midwest		
Indiana 4th vein lump	Chicago	2.75 to 3.00
Indiana 4th vein mine run	Chicago	2.25 to 2.50
South and Southwest		
Big Seam lump	Birmingham	3.30 to 3.50
Big Seam mine run	Birmingham	1.50 to 2.00
Southeast Kentucky lump	Louisville	2.50 to 2.75
Southeast Kentucky mine run	Louisville	1.50 to 2.00

B. Anthracite.

(Spot prices F. O. B. mines, gross tons),

Market	Freight rates	Independent	Company
Egg New York	$2.34	$8.50 to $13.00	$8.00 to $8.35
Egg Philadelphia	2.39	9.25 to 11.00	8.10 to 8.35
Egg Chicago (net tons)	5.06	8.50 to 12.00	7.25 to 7.45

COKE (By Courtesy of Iron Trade Review).

Connellsville, furnace	$3.00
Wise County, furnace	$3.75 to 4.50
Alabama, furnace	4.50 to 5.00
Foundry, Newark, N. J., del.	10.41
Foundry, Chicago, ovens	10.75
Foundry, Boston, delivered	11.50
Foundry, St. Louis	11.00
Foundry, Granite City, Ill.	9.00
Foundry, Alabama	4.50 to 5.50

PETROLEUM (By Courtesy of Oil, Paint & Drug Reporter)

(Prices at wells, per bbl.)

Pennsylvania—Ohio—West Virginia.	
Cabell, West Virginia	1.45
Corning, Ohio	1.75
Lima	1.83
Pennsylvania	$2.75 to 2.85
Wooster, Ohio	1.65
Indiana—Illinois.	
Illinois	1.62
Indiana	1.63
Oklahoma—Kansas.	
Healdton	.90
Mid-continent (low gravity)	.90 to 1.05
Gulf Coast.	
Gulf Coast, Grade A	$1.35
Gulf Coast, Grade B	1.15

GAS OILS.

Gas Oil, Bayonne, bulk gal.	5¼ to 5½c
Gas Oil (32-36) Oklahoma, gal.	2⅝ to 2⅞c
Gas Oil (32-36) Gulf Coast, gal	4 to 4¼c

PIPE AND FITTINGS—CAST IRON GAS PIPE.

(By Courtesy Iron Trade Review.)

Four-inch, Chicago	$61.20 to $62.20
Six-inch and over, Chicago	57.20 to 59.20
Four-inch, Birmingham	56.00 to 59.00
Six-inch and over, Birmingham	52.00 to 53.00
Four-inch, New York	69.60 to 71.60
Six-inch and over, New York	64.60 to 65.60
Standard fittings, Birmingham, base	115.00

6 to 24-inch, base; over 24-inch, plus $20; 4-inch, plus $20; 3-inch, plus $20.

BY-PRODUCTS

(By Courtesy of Oil, Paint and Drug

Ammonia aqua, 16 deg. drums lb.	5 to 5¼c
Ammonia aqua, 20 deg. drums lb.	6¼ to 6½c
Ammonia aqua, 26 deg. drums lb.	6½ to 7 c
Ammonia squa, anhydrous cylinder, lb.	30 to 36 c
Ammonium sulphate, bulk F. O. B. Works, per 100 lbs.	$2.55
Potash prussiate, yellow casks, lb.	18½ to 19 c
Potash prussiate, red casks, lb	37½ to 40 c
Soda prussiate, yellow casks.	10 to 10½c
Soda sulphocyanide, barrels, lb.	45 to 55 c

COAL TAR BASIC PRODUCTS.

(By Courtesy of Oil, Paint and Drug Reporter)

Benzol C. P. tanks, works, gal.	24 to 25c
Benzol, drums, gal.	30c
Benzol, 90% tanks, works, gal.	23c
Benzol, 90% drums, gal.	28c
Napthalene, flake, barrels, lb.	4¾ to 5¼c
Napthalene, dyestuff bags, lb.	4½ to 5 c
Solvent Naphtha, water white works, gal.	24 to 25c
Solvent Naphtha, drums, works, gal.	29 to 30c
Toluene, C. P. tanks, works, gal.	31c
Toluene C. P. drums, works, gal.	36c

COAL

Production of bituminous coal again increased slightly during the week ended August 16, the output, according to the Geological Survey, totaling 7,831,000 net tons. This compares with an output of 7,789,000 net tons during the week ended August 9, according to revised figures. Anthracite production, however, showed a marked falling off, 1,386,000 net tons having been produced during the week ended August 16, compared with 1,664,000 net tons during the preceding week.

Anthracite also showed slight indications of an early upturn, though tangible evidence in the shape of actual orders is still rather meager.

CRUDE OIL

A material gain in average daily gross domestic crude oil production was reported by the American Petroleum Institute for the week ended August 16, the increase totaling 18,700 barrels. The institute estimates daily production for the week at 2,029,650 barrels, as compared with 2,010,950 barrels for the preceding week. Daily average production east of the Rocky Mountains was 1,411,200 barrels as compared with 1,387,800 barrels, an increase of 23,400 barrels.

NEWS OF THE GAS INDUSTRY

Fine Program Arranged for Michigan Gas Meeting

"Five Years' Experience with Vertical Retorts at Fond du Lac, Wisconsin"—M. H. Frank.

"Locating and Reducing Excessive Use of Boiler Fuel in Small Gas Plants"—C. L. C. Kah.

"Electrical Precipitation of Water Gas Tar"—Charles F. Morris.

"Labor Saving Machinery for Street Construction Work"—J. W. Batten.

"Trenching Machines"—A. G. Ford.

"One Season's Experiences in House Heating with Gas at Salt Lake City"—George R. Horning.

"Doherty Three Part Gas Rate"—D. E. Byerly.

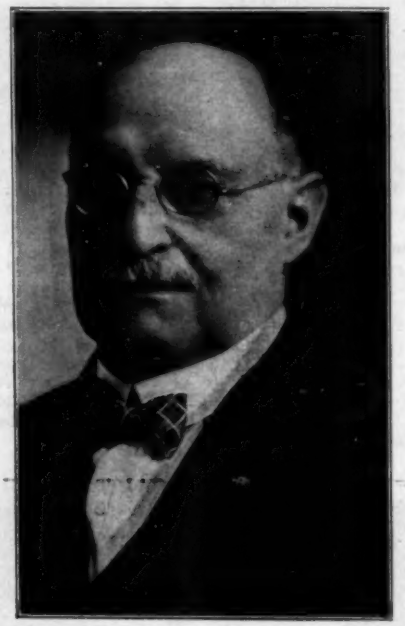
"Coke Sales from the Standpoint of the Smaller Properties"—F. E. Caton.

There will be a joint meeting of the Michigan Gas Association and the Michigan Electric Light Association on the evening of September 9th. This program will be in charge of the Michigan Committee on Public Utility Information. The Michigan Electric Light Association will hold its meeting in Detroit on September 10th and 11th, independent, of course, of the Gas Association meeting, but the latter has joined with them in the entertainment features.

William J. Dorr Passes Away

Coming as a shock to all who knew him was the death, on August 7, of William Joseph Dorr, retired superintendent gas distribution for Los Angeles Gas and Electric Corporation. His widow, Mrs. Nellie E. Dorr, survives.

A native Californian, Mr. Dorr was born January 2, 1859, at San Francisco. It was with the Napa, California, Gas Company that he got his start in the industry in which practically his whole life was spent. In the late 80's Mr. Dorr came to Los Angeles and became associated with the gas company organized by the late Professor T. S. C. Lowe. In 1889 the Los Angeles Lighting Company, predecessor of Los Angeles Gas and Electric Corporation, purchased the Lowe Company and Mr. Dorr began his continuous service of 35 years with the gas and electric company. Almost 22 years of this



period he was superintendent gas distribution for the Los Angeles utility. At the time of his death he had been retired from active service only about two months.

Mr. Dorr was a member of the American Gas Association and the Pacific Coast Gas Association, the Masons and the Odd Fellows.

Progress Club of Brooklyn Union Gas Co. Holds Outing

Fifteen hundred employees of the Brooklyn Union Gas Company attended the outing and field day given by the Progress Club at Beckman's Pavilion, Whitestone, Long Island, on Saturday, August 16, 1924.

The members boarded the steamer "Robert Warwick" at foot of 52nd Street, at 10 A. M., and the boat proceeded to foot of N. 2nd Street, where an additional four hundred members were picked up. During the trip Slaffer's band entertained with numerous popular melodies. A splendid luncheon was served on board, which was enjoyed by all.

The merrymakers arrived at the grove about 12:30 o'clock, and the athletic events for the day were run off. At 3 o'clock an elaborate dinner was served on Beckman's Pavilion. Some of the members made the trip in their automobiles, arriving in time for the bake.

Ideal weather conditions and gayety prevailed during the return trip. The beautiful moonlight, music and balmy summer night breezes combined to make the sail a highly enjoyable one.

Among those who attended the outing were: A. F. Staniford, vice-president; Henry E. McGowan, secretary; F. R. Wogan, assistant secretary; J. T. White, assistant secretary; T. P. Payne, auditor; R. W. Bush, engineer of manufacturing; Timothy Shea, of the law office of Cullen & Dykman; George M. Kirchmer, claim agent, and J. S. MacArthur, of the Metropolitan Branch.

The officers of the club are: O. C. Woller, president; E. D. Jones, secretary; Otto Aumuller, financial secretary, and E. L. Shultz, treasurer.

Peoples Gas Co. Holds Exhibit

Glassboro, N. J.—One of the most attractive exhibits at the Gloucester County Fair, held at Alcyon Park, Pitman, New Jersey, during the week of August 11th, was the up-to-date display of modern gas appliances by the Peoples Gas Company, of Glassboro, N. J.

A well balanced exhibit of domestic gas appliances was displayed in a large tent on the main thoroughfare, in the center of the Fair Grounds, emphasizing the im-

portance of gas in the present-day home, and demonstrating the artistic lighting effects which can be attained through the proper arrangement of modern gas lights.

One of the features of the exhibit which caused much favorable comment was the illumination. This was of a decorative order, and was obtained through a series of the latest types of Welsbach semi-indirect lights and wall brackets with hand painted parchment shades, which produced a very pleasing example of soft, soothing illumination.

The exhibition was staged by C. J. Wilson, new business manager, assisted by Messrs. E. E. Giesler and Everett Ellis, "go getters" of the new business department.

During the show fourteen ranges were sold and over one hundred good live prospects secured. Over ten thousand souvenirs were distributed to the ladies who visited the display.

Fine Tourists' Camp Uses Gas

The Marinette Tourists' Camp, located at Marinette, Wis., is one of the most ideal tourists' camps in the United States, having electric lights, telephone, comfort station, hot showers and artificial gas for cooking. Four hotplates are mounted in series on a steel platform and served by quarter meters.

As you will note in the picture, an invitation is extended to "Come on in and enjoy hot showers." This is made possible by the installation of two tank heaters equipped with quarter meters.

It is interesting to note that over three thousand people have visited this camp between June 1st and August 1st—a period of eight weeks.

John H. Keppleman Passes Away

Reading, Pa.—John H. Keppleman, president and manager of the Consumers Gas Co. of Reading, Pa., died suddenly after a long illness. Mr. Keppleman was 72 years old.

He had been associated with his company for 41 years, more than thirty of which he served as superintendent and the last six years as president and manager. He was president of the old Board of Trade for four terms and as a member of council under the old form of government he was a leading figure in advocating permanent municipal improvements.

Contracts Awarded

The Rochester Gas & Electric Company, of Rochester, N. Y., is remodeling and extending the capacity of its power plant by the installation of three 875 horsepower boilers fired by Taylor stokers with steam ash dump. This company has been using Taylor stokers in its power plant since 1913 and already has eight of these stokers in service under boilers of a total capacity of approximately 7,000 horsepower.

Gas Men of the P. C. G. A. Study Problems in the Southland

Frederick S. Myrtle

Men of the gas industry came from all parts of the Pacific Coast territory to attend the southern sectional gathering of the Pacific Coast Gas Association in Los Angeles, July 11 and 12.

This was the last sectional meeting on the association's program of activities prior to the annual convention which will be held in Santa Barbara during the third week in September. Last January the association held a reunion in San Francisco, and in April the men of the gas industry were called together in Seattle, so that the important points of the compass have been touched and every attention paid to the various problems that confront the gas industry on the Pacific slope. These sectional gatherings have been found of the utmost value to the industry, seeing that they enable gas men to keep in touch with one another not only at central headquarters but points outside, thereby stimulating the general interest and helping to swell the membership roll to proportions not even dreamed of when the P. C. G. A. first saw the light of day thirty-one years ago.

Business Sessions

Business sessions were held both days. They were presided over by Mr. Harold Basford, the present chief executive of the association, and attended by members of the executive committee and heads of the major standing committees. Reports were received and discussed and the slate cleaned, so to speak, for the annual convention so near at hand. An important subject of discussion was the proposed reorganization of the association through a revision of its constitution and by-laws. It is proposed thereby to rearrange the association membership into classes and to put the direct management of association's affairs into the hands of an executive secretary, who shall devote his whole time and attention to the work at permanent headquarters in San Francisco and with such clerical help as may be needed.

Early in June the announcement was made that permanent headquarters had been selected in the Wells Fargo Building, San Francisco, under an assistant secretary, Mr. Clifford Johnstone, a gas man from the Southland. Mr. Johnstone is well qualified for the work he has undertaken. He has had experience in hydraulic engineering and as editor of a trade journal. He was a member of the engineering staff of the California State Railroad Commission for four years and is thoroughly trained in civil engineering. He knows the technical side of the gas

business, is well acquainted with a vast number of gas men in the industry, is familiar with gas utilities and their problems. So, the association may be congratulated upon securing his services. It goes without saying that when the plan of reorganization is adopted Mr. Johnstone will be invested with the title of executive secretary.

Arrangements for Annual Convention

Another matter disposed of at the business session was the adoption of final arrangements for the Santa Barbara convention, which will be the thirty-first annual gathering of the P. C. G. A. since its inauguration in 1893. It will be called together the afternoon of September 15th and will sit during the balance of the week. On account of the increased interest in the different branches of the gas industry whose representatives make up the personnel of the association, it has been decided to hold parallel sessions this year. There will, of course, be the usual program of entertainment and, as is customary upon such occasions, the gold tournament will attract general interest.

Cracking of Natural Gas

Probably the most important feature of the gathering in Los Angeles was the technical session held on the afternoon of July 12th in the new headquarters building of the Southern California Gas Company at Tenth and Santa Fe Streets. Papers of an unusually interesting character were presented by Messrs. Harry L. Masser, formerly gas engineer of the State Railroad Commission and now in the employ of the Los Angeles Gas & Electric Corporation, and Charles M. Grow of the Southern California Gas Company. Mr. Masser's paper dealt with the reforming or "cracking" of natural gas, a practice adopted by gas companies in the Southland, particularly in Los Angeles and Santa Barbara. This reforming process consists of a breaking up of the natural gas into a gas whose characteristics are similar to those of manufactured gas. The natural gas is put through regular oil gas generators and subjected to a temperature of approximately 1,800 degrees Fahrenheit, the result being a product of lower heating value than natural gas but of largely increased volume. The process described is unique to California and the results obtained are so beneficial as to be of interest to the gas industry everywhere.

Mr. Grow's paper was on the activities of gas companies in promoting industrial gas sales. It was, in effect, a history of this phase of the business from the beginning and showed the vast strides made by the companies in calling general attention to the value of gas as an industrial fuel.

Banquet Closes Convention

The gathering closed on the evening of July 12th with a banquet at the Hotel Alexandria in Los Angeles at which the assemblage numbered 314, an unusual turnout for a sectional occasion. There were two leading speakers on the program. First came Professor C. A. Gummere, lecturer on Commerce in the University of Southern California, who entitled the subject of his address "Knowing." In this he made the point that education was the main factor in any successful career. Knowledge he regarded as a common medium of exchange, while education was like a pipe leading down to an oil well through which the oil was reached and piped to the surface. Statistics showed that 80 per cent of the positions of trust in the United States were held by college bred men, and Professor Gummere quoted several men of world prominence upon the value of learning, including Kant, who said, "Man becomes man only by process of education"; Edmund Burke, who declared that education was the chief defense of the nation; Knox, who was quoted as saying, "Every scholar is something added to the wealth of the universe"; Humboldt, who declared that "What you would put into the State you must first put into the schools"; then, coming to the present day, H. G. Wells, who said, "History is a race between education and disaster," and Roger Babson, the well-known publicist, who said, "We insure our houses, our factories, but the same amount invested in a Christian education will achieve greater results."

Professor Gummere presented his points in hammer-like fashion and made a deep impression. He was followed by Mr. James W. Foley, poet, humorist and newspaper man in active service, who in his quaint, original fashion preached the gospel of optimism. His was the doctrine of happiness, with the advice, "Do something useful and be happy in the doing of it." Upon the subject of public relations for the public utility and the gas industry generally he presented this word of a world philosophy:

"Once you have established the basis of friendly understanding you have built a highway along which you can walk to the hearts of the people."

Convention Was a Decided Success

President Harold Basford has reason to congratulate himself upon a most successful gathering, one which augurs well for the success of the Santa Barbara convention. It is of interest to know that the P. C. G. A. which has started from small beginnings now numbers approximately 880 men, including representatives of every branch of the gas industry on the coast. The present working organization of the association consists of the following: President, H. R. Basford; vice-president, E. L. Hall; secretary-treasurer, W. M. Henderson; assistant secretary, Clifford Johnstone; directors, Wm. Moeller, A. B. Day, M. R. Thompson, W. S. Yard, C. B. Babcock, L. M. Klauber, Van E. Britton. Following are the standing committees:

Meetings Committee, E. L. Hall, chairman; Arrangements Committee, Norman R. McKee, chairman; Publicity Committee, F. S. Myrtle, chairman; Experience Committee, John Clements, chairman; Technical Committee, W. S. Yard, chairman; Commercial Committee, L. F. Galbraith, chairman; Public Relations Committee, D. C. Ray, chairman; Accounting Committee, C. W. Platt, chairman; Membership Committee, W. M. Duggan, chairman Northern Section; Fred Champion, chairman Southern Section; F. U. Naylor, chairman Central Section.